

GTE-ERS
TECHNICAL LIBRARY



02840

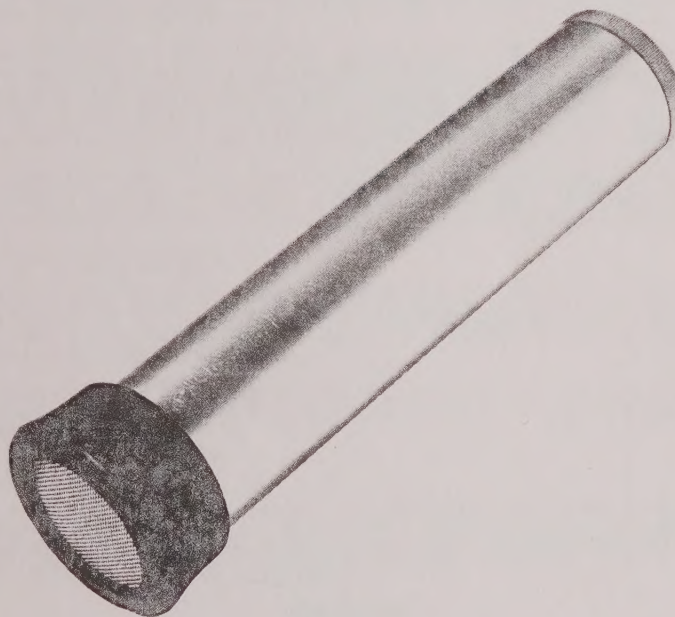


ESC-0620-92-01

HWPC 18020A

GENERAL PURPOSE PROBE

MODEL 18020A



HEWLETT
PACKARD



HEWLETT
PACKARD

SAFETY

This product has been designed and tested according to International Safety Requirements. To ensure safe operation and to keep the product safe, the information, cautions, and warnings in this manual must be heeded. Refer to Section I for general safety considerations applicable to this product.

CERTIFICATION

Hewlett-Packard Company certifies that this product met its published specifications at the time of shipment from the factory. Hewlett-Packard further certifies that its calibration measurements are traceable to the United States National Bureau of Standards, to the extent allowed by the Bureau's calibration facility, and to the calibration facilities of other International Standards Organization members.

WARRANTY

This Hewlett-Packard product is warranted against defects in material and workmanship for a period of one year from date of shipment [, except that in the case of certain components listed in Section I of this manual, the warranty shall be for the specified period] ¹. During the warranty period, Hewlett-Packard Company will, at its option, either repair or replace products which prove to be defective.

For warranty service or repair, this product must be returned to a service facility designated by HP. However, warranty service for products installed by HP and certain other products designated by HP will be performed at Buyer's facility at no charge within the HP service travel area. Outside HP service travel areas, warranty service will be performed at Buyer's facility only upon HP's prior agreement and Buyer shall pay HP's round trip travel expenses.

For products returned to HP for warranty service, Buyer shall prepay shipping charges to HP and HP shall pay shipping charges to return the product to Buyer. However, Buyer shall pay all shipping charges, duties, and taxes for products returned to HP from another country.

LIMITATION OF WARRANTY

The foregoing warranty shall not apply to defects resulting from improper or inadequate maintenance by Buyer, Buyer supplied software or interfacing, unauthorized modification or misuse, operation outside of the environmental specifications for the product, or improper site preparation or maintenance.

NO OTHER WARRANTY IS EXPRESSED OR IMPLIED. HP SPECIFICALLY DISCLAIMS THE IMPLIED WARRANTIES OF MERCHANTABILITY AND FITNESS FOR A PARTICULAR PURPOSE.

EXCLUSIVE REMEDIES

THE REMEDIES PROVIDED HEREIN ARE BUYER'S SOLE AND EXCLUSIVE REMEDIES. HP SHALL NOT BE LIABLE FOR ANY DIRECT, INDIRECT, SPECIAL, INCIDENTAL, OR CONSEQUENTIAL DAMAGES, WHETHER BASED ON CONTRACT, TORT, OR ANY OTHER LEGAL THEORY.

ASSISTANCE

Product maintenance agreements and other customer assistance agreements are available for Hewlett-Packard products.

For any assistance, contact your nearest Hewlett-Packard Sales and Service Office. Addresses are provided at the back of this manual.



Digitized by the Internet Archive
in 2025



OPERATING AND SERVICE MANUAL

GENERAL PURPOSE PROBE MODEL 18020A

© Copyright Hewlett-Packard Company 1970
Colorado Telecommunications Division
5070 Centennial Blvd., P.O. Box 7050, Colorado Springs, CO 80933

Manual Part No. 18020-90001

Microfiche Part No. 18020-90002

Revised: JUL 1982

TABLE OF CONTENTS

Section	Page
I	GENERAL INFORMATION
1-1.	General 1-1
1-3.	Description 1-1
1-11.	Instrument Identification 1-2
1-13.	Specifications 1-2
II	INSTALLATION
2-1.	Introduction 2-1
2-3.	Unpacking and Inspection 2-1
2-5.	Storage and Reshipment 2-1
2-6.	Packaging 2-1
III	OPERATION
3-1.	Introduction 3-1
3-3.	Directivity 3-1
3-5.	DC Power 3-1
3-7.	Connecting Probe to Ultrasonic Translator Detector . . . 3-1
3-9.	Operational Check 3-2
IV	THEORY OF OPERATION
4-1.	General 4-1
4-3.	Microphone Assembly 4-1
4-5.	Signal Processing 4-1
V	MAINTENANCE
5-1.	Introduction 5-1
5-3.	Test Equipment 5-1
5-5.	Performance Checks 5-1
5-7.	Output Noise-Level Check 5-1
5-9.	Sensitivity Check (Standard Leak Test) 5-4
5-11.	Adjustment and Calibration Procedures 5-5
5-14.	Adjusting Noise Figure and Gain 5-5

TABLE OF CONTENTS (Continued)

Section	Page
5-16. Troubleshooting	5-7
5-22. Circuit Board Repair	5-8
VI	REPLACEMENT PARTS
6-1. Introduction	6-1
6-4. Ordering Information	6-1
APPENDIX A	Backdating A-1

LIST OF ILLUSTRATIONS

Figure		Page
1-1.	Model 18020A General Purpose Probe	1-0
4-1.	General Purpose Probe Schematic Diagram	4-3
5-1.	Test Cord for Output Noise-Level Check	5-3
5-2.	Output Noise-Level Test Setup	5-4
5-3.	Sensitivity Check Test Setup.	5-5
5-4.	Calibration and Adjustment, Test Setup	5-6
5-5.	General Purpose Probe Circuit Board, Parts Location.	5-7
6-1.	Mechanical Assembly	6-2

LIST OF TABLES

Table		Page
1-1.	Specifications	1-2
2-1.	Shipping Carton Test Strength.	2-2
5-1.	Test Equipment	5-2
5-2.	Transistor Voltages.	5-8
6-1.	Model 18020A Electrical Parts	6-1
6-2.	Mechanical and Chassis Mounted Electrical Parts.	6-3



Figure 1-1. Model 18020A General Purpose Probe

SECTION I

GENERAL INFORMATION

1-1. GENERAL

1-2. The Hewlett-Packard Model 18020A General Purpose Probe (figure 1-1) functions with the HP Ultrasonic Translator Detector receivers to detect and amplify ultrasonic energy waves having frequencies ranging from 36 kHz to 44 kHz.

1-3. DESCRIPTION

1-4. The HP 18020A consists of a microphone and preamplifier housed in a 1-3/8-inch diameter nickel-plated brass tube. Power for the preamplifier is provided by the translator receiver through the connecting cord. A screen cap protects the open front against dirt.

1-5. The barium titanate ceramic-bender type microphone couples to the atmosphere by way of a quarter-wavelength acoustic matching transformer and a conical horn.

1-6. The preamplifier includes one high-gain, low-noise stage followed by an emitter-follower to ensure minimum loss when long cables are used to connect the probe output.

1-7. Electrical connection is made to the general purpose probe through a three-pin male electrical connector (HP Stock No. 5080-8502) at the rear of the probe. The connector mates with the HP Model 18015A Coil Cord. The female connector on the 18015A has HP Stock Number 1251-2115.

1-8. The HP Model 18014A Protective Cap provided with the probe comprises a monel screen held in a flexible rubber mount that fits over the end of the probe housing. The cap protects the probe against the entrance of foreign material.

1-9. The ruggedly-constructed general purpose probe can withstand reasonable shock and vibration but should be protected from excessive moisture.

1-10. The HP Model 18013A Focusing Cap Extension, available as an optional accessory, is a flexible rubber tube used to extend the probe to provide easier to out-of-the-way sources of ultrasonic energy. The use of the Model 18013A reduces the sensitivity of the probe somewhat, but this is of little consequence because the extension is used only for pinpointing the location of a leak at very short range.

1-11. INSTRUMENT IDENTIFICATION

1-12. All inquiries regarding operation, calibration/adjustment, and service should be accompanied by complete model number and serial number.

1-13. SPECIFICATIONS

1-14. Table 1-1 lists the physical and electrical characteristics of the Model 18020A General Purpose Probe.

Table 1-1. Specifications

CHARACTERISTIC	DESCRIPTION
Conical Directivity	22 degrees
Threshold Sensitivity (for 3 dB S/N)	40 dB below 1 μ bar
Frequency Range	33 kHz to 44 kHz
Power Requirement	3.0 $\pm$ 0.5 VDC
Dimensions	6.312 inches (21.933 cm) long x 1.375 inches (3.472 cm) out- side diameter
Weight	10.5 oz (297 gm), net 2 lbs (907 gm), shipping

SECTION II INSTALLATION

2-1. INTRODUCTION

2-2. This section contains information on unpacking, inspection, storage and re-shipment.

2-3. UNPACKING AND INSPECTION

2-4. If the shipping carton is damaged, ask that the carrier's agent be present when the instrument is unpacked. Inspect the instrument for damage (scratches, dents, etc.). If the instrument is damaged or fails to operate, notify the carrier and Hewlett-Packard immediately. (See "Warranty and Assistance" in the front of this manual.) Retain the shipping carton and the padding material for the carrier's inspection. Hewlett-Packard will arrange for the repair or replacement of your instrument without waiting for any claim against the carrier to be settled.

2-5. STORAGE AND RESHIPMENT

2-6. Packaging

2-7. To protect the instrument against the normal hazards of shipping, use the best packaging materials available. The original carton and packaging material should be reused for shipment. If original materials are unavailable or not reusable, pack instrument as follows:

- a. Use a double-walled carton that meets the requirements of table 2-1.
- b. Protect all surfaces with heavy paper, plastic, or sheets of cardboard. Use non-abrasive materials, such as foam rubber or soft-cushioning paper, around all projecting parts.
- c. Tightly pack at least 4 inches of industry-approved, shock-absorbing material around the top, bottom, and each side of the instrument.

Table 2-1. Shipping Carton Test Strength

GROSS WEIGHT (lbs)	CARTON TEST STRENGTH (lbs)
up to 10	200
10 to 30	275
30 to 120	350
120 to 140	500
140 to 160	600

- d. Secure the outside of carton with heavy-duty shipping tape: mark "DELICATE INSTRUMENT" on each side of box.
- e. When an instrument must be returned, enclose a note containing the sender's name, address, and telephone number. Also, include the reason for return and, if the instrument is not under warranty, a repair authorization.

SECTION III OPERATION

3-1. INTRODUCTION

3-2. This section contains only enough operating information to facilitate maintenance of the HP Model 18020A General Purpose Probe. For further operating information, refer to the Operating Manual for any of the Hewlett-Packard Ultrasonic Translator Detectors that use the Model 18020A General Purpose Probe.

3-3. DIRECTIVITY

3-4. Because of its narrow conical response pattern the probe must be pointed at the source of ultrasonic energy to achieve maximum sensitivity. In practice, the high directivity of the probe is useful for precisely locating a source of ultrasonic energy.

3-5. DC POWER

3-6. Ordinarily, the Ultrasonic Translator Detector to which the probe connects supplies the 3 VDC, 0.6 mA power required for operating the preamplifier. If the probe is to operate independently of an Ultrasonic Translator Detector Receiver, two mercury or other primary cells in series can be used as an external power supply. A power supply operating from an AC source must have less than 50 μ V ripple and noise. (Hewlett-Packard Model 6102A meets this requirement.)

3-7. CONNECTING PROBE TO ULTRASONIC TRANSLATOR DETECTOR

3-8. Ordinarily, the 6-foot HP Model 18015A Coil Cord or the 25-foot HP Model 18016A cord connects the Probe to the Ultrasonic Translator Detector. A special, shielded cord up to 500 feet long having negligible loss can be made up using cable with less than 75 pF capacitance per foot and wire size greater than 20 circular mils.

3-9. OPERATIONAL CHECK

3-10. When using the probe with one of the Ultrasonic Translator Detector receivers, check the operational readiness of the combined instruments as follows: Turn on the Ultrasonic Translator Detector; turn gain control to midrange setting. Rub thumb and forefinger together about an inch away from and directly in front of the probe. Listen for audible sound and observe meter deflection indicating probe is operating.

SECTION IV THEORY OF OPERATION

4-1. GENERAL

4-2. Electrically, the General Purpose Probe consists of a microphone assembly and an all-solid-state, printed circuit preamplifier assembly.

4-3. MICROPHONE ASSEMBLY

4-4. Microphone MK201 (figure 4-1) contains a molded-plastic conical horn having a quarter-wavelength matching section at the small end. Attached to the matching section, a crystal holder houses a barium-titanate bender-type ceramic transducer. A small aluminum bridge, or saddle, mounted on the transducer broadens the response band of the microphone and improves impedance matching to the quarter-wavelength horn and the matching section.

4-5. SIGNAL PROCESSING

4-6. The electrical signal from microphone MK201 couples through capacitor C202 to amplifier stage Q201. Adjustable inductor L201 provides optimum signal-to-noise ratio. Feedback resistor R201 stabilizes the gain of Q201.

4-7. Potentiometer R202 sets the gain of the probe. Capacitor C203 couples the signal to the base of emitter follower Q202. The output from the emitter of Q202 couples through capacitor C204 to connector J201.

4-8. Power (-3 VDC at 0.6 mA) is supplied to the probe through pin 2 of connector J201. Ground connection is made at pin 1.

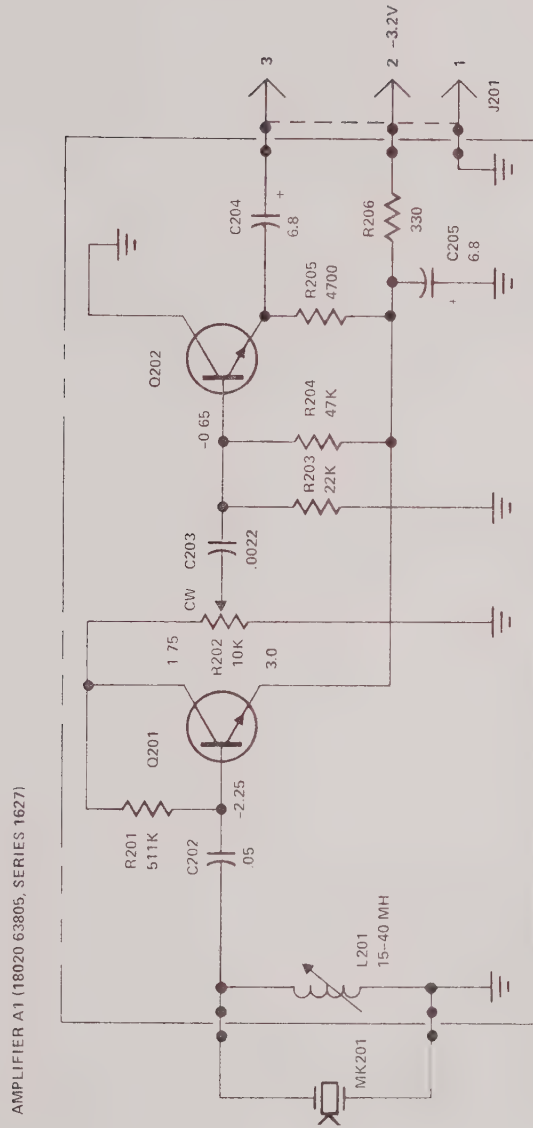


Figure 4-1. General Purpose Probe Schematic Diagram

SECTION V MAINTENANCE

5-1. INTRODUCTION

5-2. This section provides performance checks, adjustment and calibration procedures, troubleshooting information, and repair methods needed for adequately maintaining the Model 18020A General Purpose Probe.

5-3. TEST EQUIPMENT

5-4. Table 5-1 lists the test equipment required for checking and maintaining the Model 18020A General Purpose Probe. The table indicates the critical specifications, use, and recommended model of each item of test equipment.

5-5. PERFORMANCE CHECKS

5-6. Performance checks include an output noise-level check and a sensitivity check.

5-7. Output Noise-Level Check

5-8. Check the output noise-level of the probe as follows:

- a. Using the test cord shown in figure 5-1, connect the probe output to an Ultrasonic Translator Detector for probe power and to an HP Model 3400A AC Voltmeter to measure the output noise-level. (See figure 5-2.)
- b. Holding a wad of cotton or similar material firmly in the mouth of the probe, turn on the Translator Detector and read the level of the probe output noise on the voltmeter. Verify the noise-level does not exceed 50 μ V.

Table 5-1. Test Equipment

INSTRUMENT	CRITICAL SPECIFICATIONS	USE	RECOMMENDED
Blank Cap	3/8-inch blank cap	Performance Check	Madden 4620-4
Orifice Cap	0.005-inch diameter orifice in 3/8-inch cap	Performance Check	HP P/N 5020-5210
Nitrogen Pressure Tank	2000-lb pressure	Performance Check	Union Carbide
Pressure Gauge and Regulator	0-175 lbs pressure	Performance Check	Union Carbide
Ultrasonic Trans-lator Receiver		Performance Check	HP 4918A, HP 4905A, HP 4916A, or HP 4917A
AC Voltmeter, true RMS	Accuracy ± 0.2 dB, input resistance 10 megohm	Calibration and Adjustment	HP 3400A
Power Amplifier	Output 20 volts peak frequency response dc to 1 MHz	Calibration and Adjustment	HP 467A
Variable Filter	Passband 36 kHz to 44 kHz	Calibration and Adjustment	Krohn-Hite 314
Random Noise Generator	Frequency spectrum 20 kHz to 5 MHz 0-5 volts peak to peak	Calibration and Adjustment	General Radio 1390B
Speaker	Frequency response 3500-200,000 Hz	Calibration and Adjustment	Ling-Temco-Vogt
Power Supply	0-320 VDC 0-0.6 A	Calibration and Adjustment	HP 890A
Condenser Microphone with Cathode Follower	Sensitivity 0.2 mV/ μ bar Free-field frequency flat to 100 kHz	Calibration and Adjustment	Bruel-Kjaer 4135
Anechoic Chamber	10" x 14" x 13" acoustically treated	Calibration and Adjustment	
Test Cable (3 required)	5 foot long, alligator to banana	Calibration and Adjustment	HP 11002A
Test Cable (2 required)	4 foot long, BNC connectors	Calibration and Adjustment	HP 10503A

Table 5-1. Test Equipment (Continued)

INSTRUMENT	CRITICAL SPECIFICATIONS	USE	RECOMMENDED
Adaptor Connectors (7 required)	BNC to banana	Calibration and Adjustment	HP 10111A
Connector	Plug, telephone, 2 conductor single	Calibration and Adjustment	HP Part No. 1251-0067

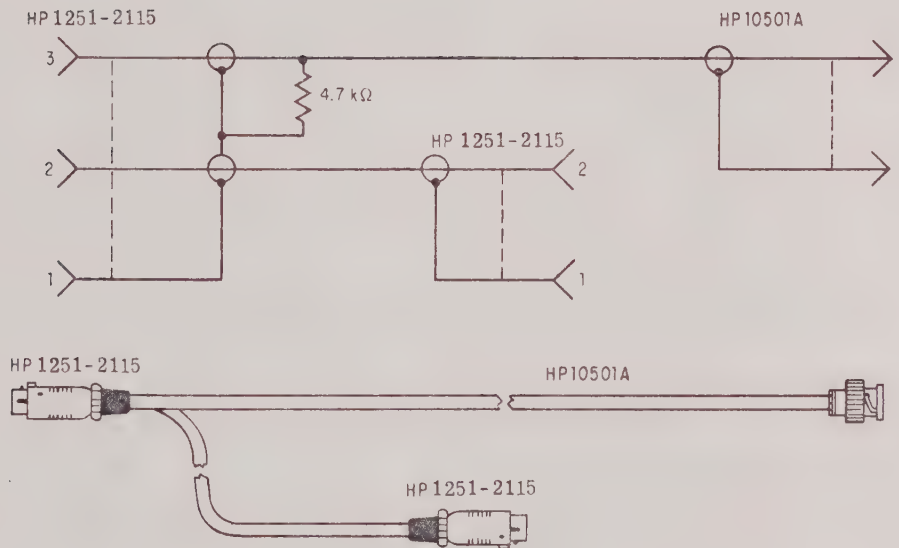


Figure 5-1. Special Test Cable

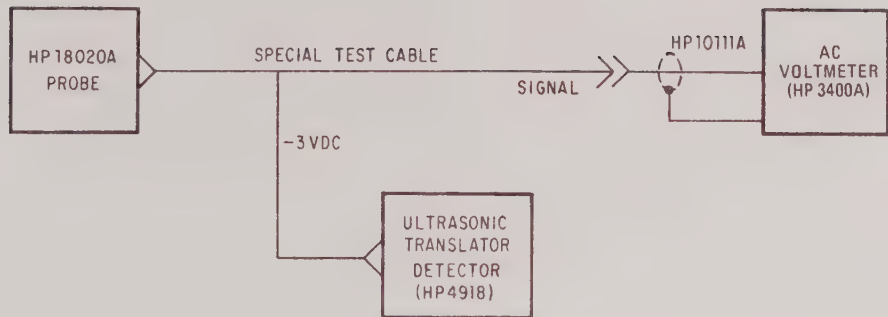


Figure 5-2. Output Noise-Level Test Setup

5-9. Sensitivity Check (Standard Leak Test)

5-10. Check the sensitivity of the probe as follows:

- a. Using the special test cord shown in figure 5-1, connect probe as shown in figure 5-2.
- b. Connect the nitrogen cylinder, pressure regulator, and blank cap as shown in figure 5-3.
- c. Adjust pressure so pressure gauge indicates 12 psi; then check system for leaks, using an Ultrasonic Translator Detector. Substitute orifice cap for blank cap.
- d. Point probe at orifice cap, firmly supporting the probe opening about 18 inches from the orifice and at the level of the cap.
- e. Adjust nitrogen pressure to 1 psi to provide a sound pressure level approximately 40 dB below 1 μ bar at the mouth of the probe.
- f. Verify AC voltmeter indicates approximately 0.2 mV.

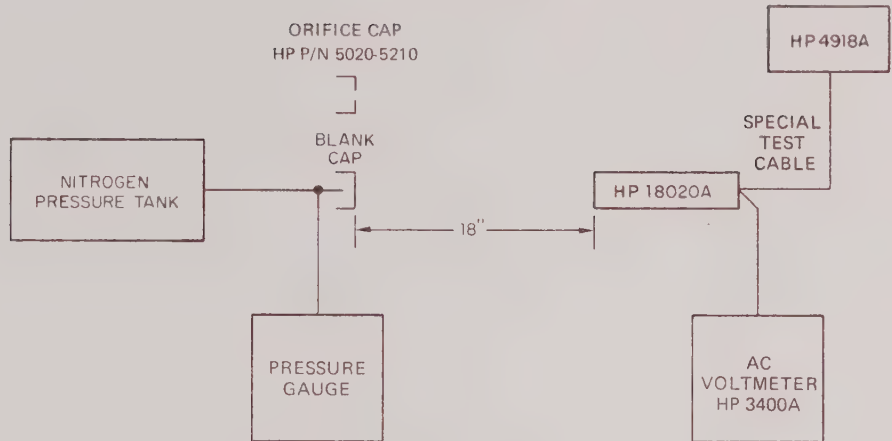


Figure 5-3. Sensitivity Check Test Setup

5-11. ADJUSTMENT AND CALIBRATION PROCEDURES

5-12. Following are complete procedures for adjusting and calibrating the Model 18020A. These procedures should be done only if performance checks indicate the Model 18020A does not perform as specified.

5-13. If calibration and adjustment of the probe fail to correct faulty operation, refer to paragraph 5-16 for troubleshooting information and recommended corrective action.

5-14. Adjusting Noise Figure and Gain

5-15. Adjust the Model 18020A noise figure and gain as follows:

- a. Connect test setup shown in figure 5-4.
- b. Set translator receiver gain control to midrange position.
- c. On noise generator, set range to 500 kHz and adjust output to 0.4 V.

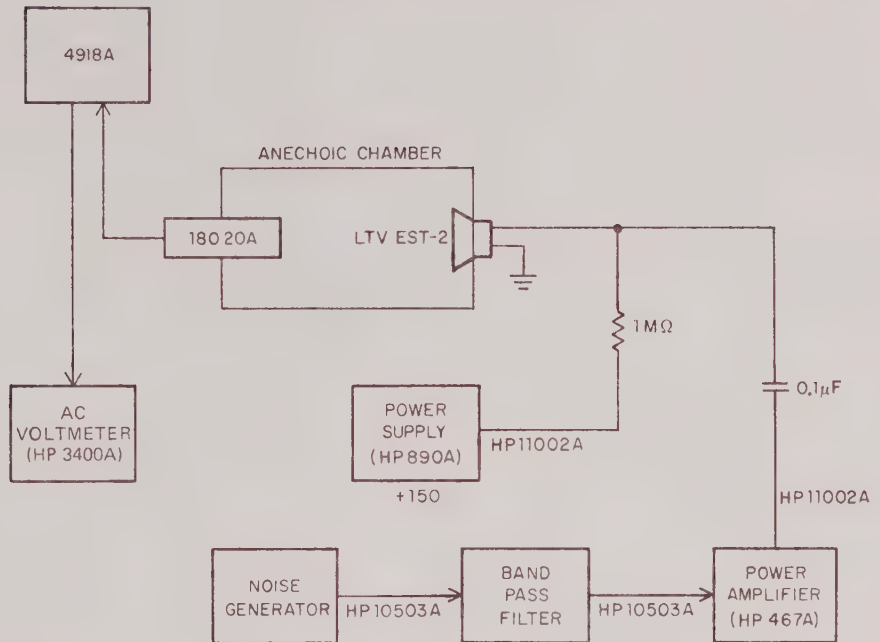


Figure 5-4. Calibration and Adjustment, Test Setup

- d. Set variable filter for 36-kHz to 44-kHz passband.
- e. Set attenuator to 60 dB
- f. Position amplifier gain switch to X10.
- g. On 18020A circuit card, adjust L201 (figure 5-5) to obtain peak indication of AC voltmeter.
- h. On circuit card, adjust R202 to obtain a 700-mV indication on AC voltmeter.
- i. Disconnect drive from transducer.
- j. Observe indication on AC voltmeter. Verify S/N equals 10 dB $\pm$ 3 dB.

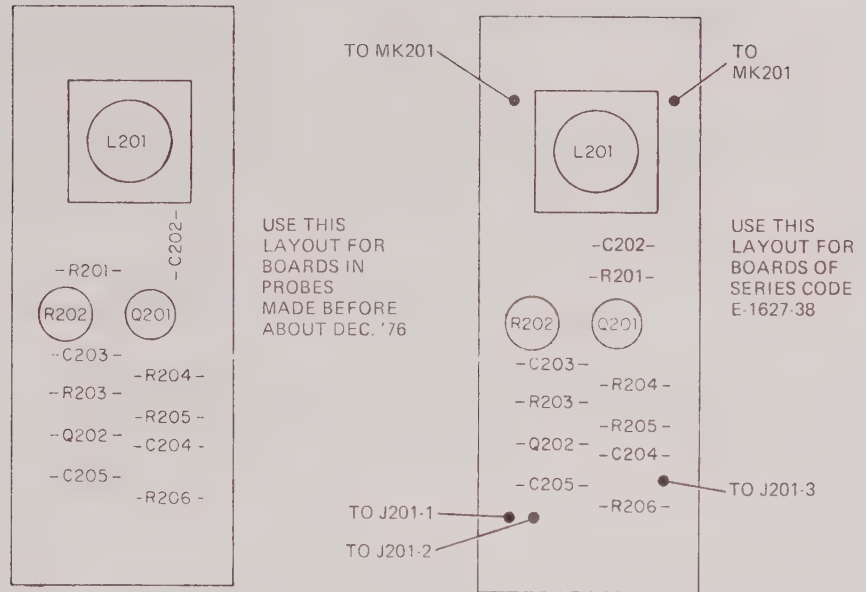


Figure 5-5. General Purpose Probe Circuit Board, Parts Location

- k. On 18020A circuit board, adjust L201 fully clockwise, then adjust counterclockwise to obtain a peak indication on AC voltmeter. After obtaining peak indication on voltmeter, continue counterclockwise adjustment of L201 to decrease indication to 3 dB below peak.
- l. Repeat a through j for final adjustment.
- m. Restore probe to normal operating condition.

5-16. TROUBLESHOOTING

5-17. If the Model 18020A fails to function correctly, first make sure the apparent-malfunction does not result from conditions external to the instrument by making the operational check described in section III.

5-18. After isolating the fault to the Model 18020A, proceed with calibration and adjustment of the instrument.

5-19. After eliminating misadjustment as the cause of the trouble, visually check the Model 18020A General Purpose Probe for possibly burned or loose components, loose connections, or other conditions suggesting a source of trouble.

5-20. Check current drain by connecting a DC voltmeter across R206, the meter should indicate between 160 and 180 mV.

5-21. Almost any source of trouble in the Model 18020A can be isolated by signal tracing using simple voltage-measuring techniques. Table 5-2 lists nominal values of DC voltages at the emitters, bases, and collectors of the two transistors in the probe circuit shown in figure 4-1.

Table 5-2. Transistor Voltages

TRANSISTOR	QUIESCENT VOLTAGE
Q201:	
Emitter	-3.0
Base	-2.25
Collector	-1.75
Q202:	
Emitter	-1.5
Base	-0.65
Collector	0

5-22. CIRCUIT BOARD REPAIR

5-23. The Model 18020A uses a plated-through, double-sided, etched circuit board. To prevent damage to the circuit board and components, observe the following rules when soldering:

- a. Use a low-heat (25 to 50 watts) soldering iron with a small tip (1/16" to 3/32" dia.).

CAUTION

EXCESSIVE OR PROLONGED HEAT
CAN LIFT THE CIRCUIT FOIL OR
CAUSE DAMAGE TO COMPONENTS.

- b. To remove a component, clip a heat sink (long nose pliers, commercial heat sink tweezers, etc.) on the component lead as close to the component as possible. Place the soldering iron directly on the component lead and pull up on the components and then remove the leads from the board.
- c. Clean the component lead holes by heating the solder in the hole, quickly removing the soldering iron, and inserting a pointed, non-metallic object such as a toothpick, or by using a "solder sucker".
- d. To mount a new component, shape the leads and insert them in the holes. Clip a heat sink on the component, heat with the soldering iron, and use solder with low rosin content as necessary to obtain a good electrical connection.
- e. Clip off excess leads after soldering and clean excess flux from the connection and adjoining area.

SECTION VI REPLACEMENT PARTS

6-1. INTRODUCTION

6-2. This section contains information for ordering replacement parts. Table 6-1 lists all electrical parts in alphanumeric order of their reference designators. Mechanical and chassis mounted electrical parts are listed in Table 6-2, in the order of key numbers in Figure 6-1.

6-3. PARTS ORDERING INFORMATION

6-4. To obtain replacement parts, address order or inquiry to the local Hewlett-Packard Sales and Service Office. (Refer to the list at the back of this manual.) Specify the following information for each part ordered:

- a. Instrument model number and serial number (if any).
- b. Option number, if any.
- c. Hewlett-Packard part number for the part.
- d. Description of each part.
- e. Circuit reference designation, if any.

Table 6-1. Model 18020A Electrical Parts

REFERENCE DESIGNATION	HP PART NO.	DESCRIPTION
A1	18020-63805	PC Board Assy A1, Amplifier
A1C201	0150-0096	Capacitor, fxd, cer, 0.05 μ F, 100 V
A1C203	0160-2597	Capacitor, fxd, cer, 0.0022 μ F
A1C204	0180-1701	Capacitor, fxd, tant, 6.8 μ F, 6 VDCW, 20%
A1C205	0180-1701	Capacitor, fxd, tant, 6.8 μ F, 6 VDCW, 20%
A1L201	9100-1732	Inductor, var, 15-40 mH
A1Q201	1854-0731	Transistor, Si, NPN, 2N5089
A1Q202	1854-0071	Transistor, Si, NPN, 2N3391
A1R201	0757-0482	Resistor, fxd, mf, 511k, 1%, 1 8W
A1R202	2100-1738	Resistor, var, cermet, lin, 10k, 30%, 1 4W
A1R203	0757-0956	Resistor, fxd, mf, 22k, 2%, 1 8W
A1R204	0757-0964	Resistor, fxd, mf, 47k, 2%, 1 8W
A1R205	0757-0940	Resistor, fxd, mf, 4.7k, 2%, 1 8W
A1R206	0698-6137	Resistor, fxd, comp, 328 ohm, 1%
J201	1251-1080	Connector
MK201	18020-63816	Microphone Assy

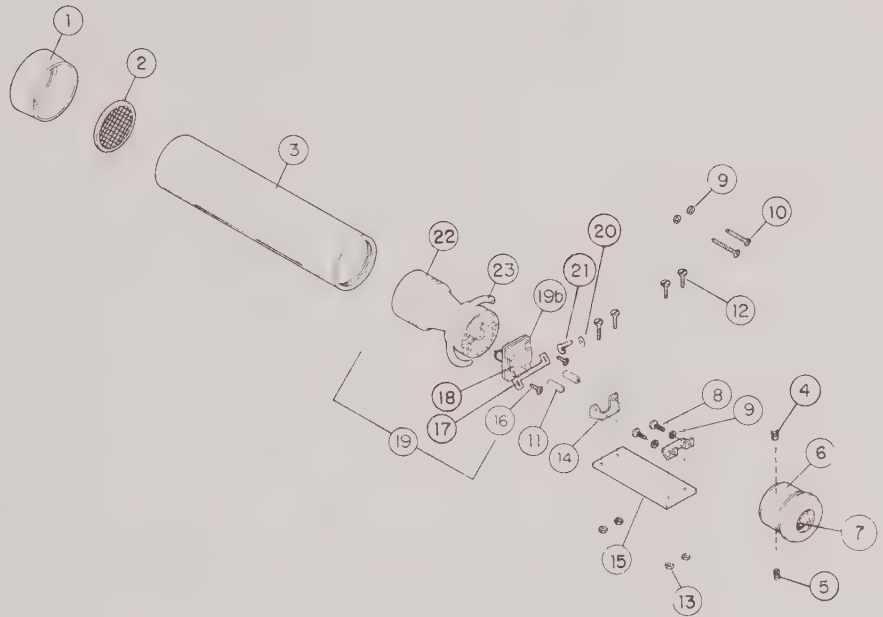


Figure 6-1. Mechanical Assembly

Table 6-2. Mechanical and Chassis Mounted Electrical Parts

KEY	HP PART NO.	DESCRIPTION	T. Q.
1	4320-0023	Cap, rubber	1
2	5000-5520	Screen, cap	1
3	18020-20030	Housing	1
4	3030-0279	Screw, set, 4-40, 1/8 in. L	1
5	0570-0184	Screw, set, 4-40, 1/4 in. L	1
6	18020-20031	End Plug, quick release	1
7	1251-1080	Connector (J201)	1
8	2200-0145	Screw, machine, 4-40 X 7/16 in.	2
9	2190-0004	Washer, Int Lock, No. 4	4
10	2200-0141	Screw, machine, 4-40 X 5/16	2
11	0380-0020	Spacer, No. 4, 1/4 in. L	2
12	2200-0139	Screw, machine, 4-40 X 1/4	4
13	2260-0009	Nut, hex, 4-40	4
14	18020-03806	Bracket, PC board	2
15	18020-63805	PC Bd Assembly A1	1
16	} SHOWN FOR REFERENCE ONLY	Screw, machine, 3-48 X 3/16	2
17		Bracket, microphone	1
18		Pad, foam, 3/16 X 1/2	1
19	18020-63816	Microphone Assy (includes keys 16, 17, 18, 19B, 20, 21, & 22)	
19B	5080-8501	Microphone, ultrasonic (MK201)	1
20	} SHOWN FOR REFERENCE ONLY	Nut, hex, 2-56	2
21		Lug, solder, No. 4	2
22		Horn, molded	1
23		O-Ring, 1 in. ID	2

REFERENCE DESIGNATORS

A	= assembly	LS	= loudspeaker
BT	= battery	M	= meter
C	= capacitor	Q	= transistor
CR	= diode	R	= resistor
J	= jack	S	= switch
L	= inductor	T	= transformer

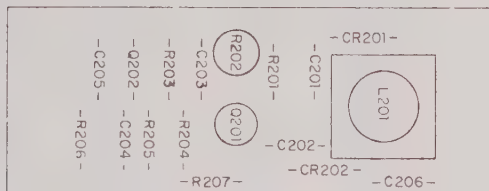
ABBREVIATIONS

A	= amperes	PF	= picofarads = 10^{-12} farads
BRS	= brass	PH BRZ	= phosphor bronze
CONN	= connector	PHL	= Phillips
ELECT	= electrolytic	PIV	= peak inverse voltage
EXT	= external	PNP	= positive-negative-positive
F	= farads	P/O	= part of
FH	= flat head	POT	= potentiometer
FXD	= fixed	PWV	= peak working voltage
H	= henries	RECT	= rectifier
HEX	= hexagonal	RMS	= root-mean square
HZ	= hertz	RWV	= reverse working voltage
ID	= inside diameter	SCR	= screw
INT	= internal	SEMICON	= semiconductor
K	= kilo = 1000	SI	= silicon
M	= milli = 10^{-3}	SST	= stainless steel
MEG	= meg = 10^{-6}	THD	= thread
MFR	= manufacturer	U	= micro = 10^{-6}
MY	= mylar	VDCW	= dc working volts
NPN	= negative-positive-negative	W/	= with
OBD	= order by description	W	= watts
OD	= outside diameter		
PC	= printed circuit		

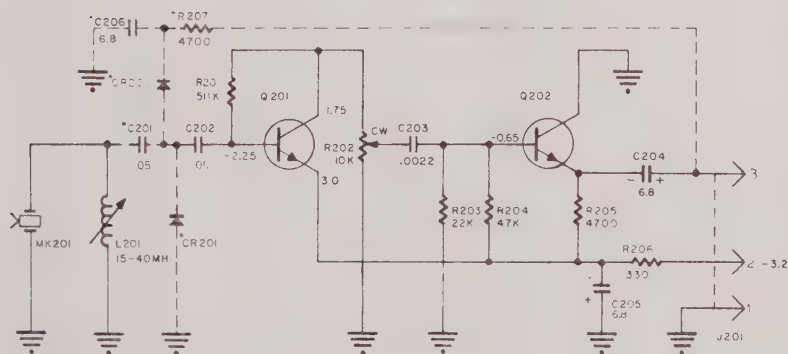
APPENDIX A BACKDATING

The following parts were used in the Model 18020A option 001. This special option probe was for use with the Model 4950A Ultrasonic Detector.

A1C201	0150-0096	Capacitor, fxd, cer, 0.05 μ F, 10%
A1C206	0180-1701	Capacitor, fxd, tant, 6.8 μ F, 6 VDCW, 20%
A1CR201	1901-0033	Diode, Si, 1N457A
A1CR202	1901-0033	Diode, Si, 1N457A
A1R207	0684-4721	Resistor, fxd, comp, 4.7k, 10%, 1/4W



Option 001 PC Board Layout



UNLESS OTHERWISE SPECIFIED—
ALL RESISTORS IN OHMS, ALL CAPACITORS IN MICROFARADS

Option 001 Schematic

1

Blackard South
Ltd
Bag Wendywood
Transvaal, 21
Blackard Centre
Great Wendy-
wood, 2144
5111/25
4782
Blackard South A

Ltd
120
Price
Province, 7450
Centre, Fore
Province, 7405
955 thru 9
7-0006

Packard Espana
az 3
el 18
58 26 00 (10
35 15 hpe
Packard Espana
Marsella
Loren

Brava, 13
34
Packard España
do 21-23
atona 17
203 8200 (5 br
2603 hobe e
Packard España

En y Capit. 1
Servilla, planta C
de 5
44 54/58
Packard Esper
Albe 17° 8
83 05/23 82 C
Packard Esper

In Gordillo 1
vicile 10
361 13 54/36
NKA
titan Agenciois
Union Place
bo 2
947

Trade
x 921
burn
048
975
LA 10
Radio Holland h

118, 77880
HEN
-Packard Sver
avägen 3, Fac
Bromma 20
8) 730 05 50
10721

MEASUREMENT
 Packard Sver
 gatan 30
 32 Vibra
 lunda
 31) 49 09 50
 10721 va Bro
 8

ZEILAND
i-Packard (Sci
rressess 20
os 307
ST Bernhard
h
1) 7305240
53833 hpag c
HPAG CH
i-Packard (Sci

221 98 03 22
27333 npag
HEWPAQUG

SALES OFFICES

Arranged alphabetically by country (cont.)



Munro & Company, Ltd.
10, Bloor St.
Sector C-64
Tel: 2954

PHILIPPINES
The Online Advanced Systems
Corporation
Rico House
Amonco cor. Herrera St.
P.O. Box 1510
Metro Manila
Tel: 85-35-81, 85-34-91,
85-32-21

TEL: 3274 ONLINE
P.O. Box 120

RHODESIA
Field Technical Sales
45 Kew Road North
P.O. Box 3458
Salisbury
Tel: 705211 (5 lines)
Telex: RH 4122

POLAND
Buro Informatyki Technicznej
Hewlett-Packard
U Stawki 2, BP
PLD-95 Warszawa
Tel: 39 58 62, 39 51 87
Telex: 81 24 53

PORTUGAL
Tecnica e Informatica
Equipamentos Electronicos
S.A.
Rua Rodrigo de Fonseca 103
P.O. Box 2531
P-Lisbon 1
Tel: 119 68 50 72
Telex: 12588

Medical Only
Mundheim
Intercomercial Mundial de
Comercio S.A.R.L.
Avenida Antonio Augusto
de Aguiar 138
P-Lisbon 1
Tel: 119 53 21 317
Telex: 19691 munde p

PUERTO RICO
Hewlett-Packard Inter-
Americas
Punto Rico Branch Office
Calle 272,
#203 Lido, Country Club
Carolina 00930
Tel: (809) 762-7255
Telex: 345 624

QATAR
Nasser Trading & Contracting
P.O. Box 1563
Doha
Tel: 4339 NASSER
Telex: 375

ROMANIA
Hewlett-Packard Inter-
Americas
Bd. Baciului 16
Bucuresti
Tel: 18 05 23/13 88 85
Telex: 10440

SAUDI ARABIA
Modern Electronic
Establishment (Head Office)
P.O. Box 1228, Baghdad
Street
Jeddah
Tel: 27 798
Telex: 40025

Cable: ELECTA JEDAH
Modern Electronic (Branch)
P.O. Box 2728
Riyadh
Tel: 825866232
Telex: 202049

Modern Electronic
Establishment (Branch)
P.O. Box 193
Al-Riyadh
Tel: 44078 44813
Telex: 870136

Cable: ELECTA AL KHOBAR
Hewlett-Packard Singapore
(Pte.) Ltd.
8B, Pichey Road
450-452 Alexandra Road
P.O. Box 58
Singapore 115
Tel: 273333 ch
Telex: 631788
Cable: HPSS RS 21486

SWITZERLAND
Hewlett-Packard (Schweiz) AG
Zürcherstrasse 20
P.O. Box 307
CH-8052 Schlieren
Tel: 01 7305240
Telex: 538633 hpd ch
Cable: HPAG CH 24

Hewlett-Packard (Schweiz) AG
Ch-1919 Le Lignon
Geneva
Tel: 0221 96 63 22
Telex: 427578 hpd ch
Cable: HPWAGK Geneva

UNITED ARAB
EMIRATES
Emtec Ltd. (Head Office)
P.O. Box 1641
Bahrain
Tel: 354 1213
Telex: 8136

SYRIA
General Electronic Inc.
Nur Bahar Annal Ebn Kaye
Street
P.O. Box 5781
Damascus
Tel: 1215 ITRAL
Cable: ELECTHOR
DAMASCOUS
Tel: 4182

Medical only
Sawah & Co.
Place Amal
B.P. 2308
Damascus
Tel: 18 367-18 697-14 258
Telex: 11004 SATACO SY
Cable: SAWAH DAMASCOUS
Suman Hani El Maw
P.O. Box 2528
Mamoun Bazar Street, 56-58
Damascus
Tel: 11 46 63
Telex: 12720
Cable: HUL DAMASCOUS
E. Madrid 16
Tel: 11 454 26 00 (10 lines)
Telex: 23515 top
Hewlett-Packard España S.A.
Colonia Meridiana
Edificio Jaban
c/o Costa Brava, 13
Madrid 34
Tel: (02) 751-0404 (15 lines)

Hewlett-Packard España S.A.
s.a.
Mansueto 21-23
E-Barcelona 17
Tel: (93) 203 6200 (5 lines)
Telex: 52603 hpd e
Hewlett-Packard España S.A.
Edificio Sella, Seville 5*
E-Seville 5
Tel: 44 5458
Hewlett-Packard España S.A.
Edificio Alba 17-B
E-Barcelona 1
Tel: 23 83 0623 82 06
Hewlett-Packard España S.A.
Oficina Gordo 1
E-Barcelona 1
Tel: 41 54 54/56 13 58

SEN LAMPA
Metropolitan Agency Ltd.
209/1 Union Place
Colombo 2
Tel: 3547
Telex: 1377MTRTOL TO

SUDAN
Radson Trade
P.O. Box 821
Khartoum
Tel: 4048
Telex: 375

SURINAM
Surin Radio Holland N.V.
Grote Hout 1-5
P.O. Box 155
Paramaribo
Tel: 7218, 7780
Telex: 375

SWEDEN
Hewlett-Packard Sverige AB
Engströmsgränd 3, Fack
S-161 Bromma 20
Tel: (08) 730 05 50
Telex: 10721
Cable: MEASUREMENTS
Stockholm
Tel: 011 7305240
Telex: 538633 hpd ch
Cable: HPAG CH 24

Hewlett-Packard (Schweiz) AG
Ch-1919 Le Lignon
Geneva
Tel: 0221 96 63 22
Telex: 427578 hpd ch
Cable: HPWAGK Geneva

TAIWAN
Hewlett-Packard Far East Ltd.
Taiwan Branch
Bank Tower, 5th Floor
205 Tung Hsu North Road
Taipei
Tel: (02) 751-0404 (15 lines)
Telex: 52603 hpd e

TANZANIA
Hewlett-Packard Ltd.
International Agency (E.A.) Ltd.
P.O. Box 861
Dar es Salaam
Tel: 21251 Ext. 255
Telex: 41020

THAILAND
UNISMA Co. Ltd.
20/200 Research Building
2538 Sathorn Ave.
Bangkok, Bangkok
Tel: 39-32-367, 39-30-338
Telex: 22984 SAMKANG

THAILAND
UNISMA Co. Ltd.
20/200 Research Building
2538 Sathorn Ave.
Bangkok, Bangkok
Tel: 39-32-367, 39-30-338
Telex: 22984 SAMKANG

THAILAND
UNISMA Co. Ltd.
20/200 Research Building
2538 Sathorn Ave.
Bangkok, Bangkok
Tel: 39-32-367, 39-30-338
Telex: 22984 SAMKANG

THAILAND
UNISMA Co. Ltd.
20/200 Research Building
2538 Sathorn Ave.
Bangkok, Bangkok
Tel: 39-32-367, 39-30-338
Telex: 22984 SAMKANG

THAILAND
UNISMA Co. Ltd.
20/200 Research Building
2538 Sathorn Ave.
Bangkok, Bangkok
Tel: 39-32-367, 39-30-338
Telex: 22984 SAMKANG

THAILAND
UNISMA Co. Ltd.
20/200 Research Building
2538 Sathorn Ave.
Bangkok, Bangkok
Tel: 39-32-367, 39-30-338
Telex: 22984 SAMKANG

THAILAND
UNISMA Co. Ltd.
20/200 Research Building
2538 Sathorn Ave.
Bangkok, Bangkok
Tel: 39-32-367, 39-30-338
Telex: 22984 SAMKANG

THAILAND
UNISMA Co. Ltd.
20/200 Research Building
2538 Sathorn Ave.
Bangkok, Bangkok
Tel: 39-32-367, 39-30-338
Telex: 22984 SAMKANG

THAILAND
UNISMA Co. Ltd.
20/200 Research Building
2538 Sathorn Ave.
Bangkok, Bangkok
Tel: 39-32-367, 39-30-338
Telex: 22984 SAMKANG

THAILAND
UNISMA Co. Ltd.
20/200 Research Building
2538 Sathorn Ave.
Bangkok, Bangkok
Tel: 39-32-367, 39-30-338
Telex: 22984 SAMKANG

THAILAND
UNISMA Co. Ltd.
20/200 Research Building
2538 Sathorn Ave.
Bangkok, Bangkok
Tel: 39-32-367, 39-30-338
Telex: 22984 SAMKANG

THAILAND
UNISMA Co. Ltd.
20/200 Research Building
2538 Sathorn Ave.
Bangkok, Bangkok
Tel: 39-32-367, 39-30-338
Telex: 22984 SAMKANG

THAILAND
UNISMA Co. Ltd.
20/200 Research Building
2538 Sathorn Ave.
Bangkok, Bangkok
Tel: 39-32-367, 39-30-338
Telex: 22984 SAMKANG

THAILAND
UNISMA Co. Ltd.
20/200 Research Building
2538 Sathorn Ave.
Bangkok, Bangkok
Tel: 39-32-367, 39-30-338
Telex: 22984 SAMKANG

THAILAND
UNISMA Co. Ltd.
20/200 Research Building
2538 Sathorn Ave.
Bangkok, Bangkok
Tel: 39-32-367, 39-30-338
Telex: 22984 SAMKANG

THAILAND
UNISMA Co. Ltd.
20/200 Research Building
2538 Sathorn Ave.
Bangkok, Bangkok
Tel: 39-32-367, 39-30-338
Telex: 22984 SAMKANG

THAILAND
UNISMA Co. Ltd.
20/200 Research Building
2538 Sathorn Ave.
Bangkok, Bangkok
Tel: 39-32-367, 39-30-338
Telex: 22984 SAMKANG

THAILAND
UNISMA Co. Ltd.
20/200 Research Building
2538 Sathorn Ave.
Bangkok, Bangkok
Tel: 39-32-367, 39-30-338
Telex: 22984 SAMKANG

THAILAND
UNISMA Co. Ltd.
20/200 Research Building
2538 Sathorn Ave.
Bangkok, Bangkok
Tel: 39-32-367, 39-30-338
Telex: 22984 SAMKANG

THAILAND
UNISMA Co. Ltd.
20/200 Research Building
2538 Sathorn Ave.
Bangkok, Bangkok
Tel: 39-32-367, 39-30-338
Telex: 22984 SAMKANG

THAILAND
UNISMA Co. Ltd.
20/200 Research Building
2538 Sathorn Ave.
Bangkok, Bangkok
Tel: 39-32-367, 39-30-338
Telex: 22984 SAMKANG

THAILAND
UNISMA Co. Ltd.
20/200 Research Building
2538 Sathorn Ave.
Bangkok, Bangkok
Tel: 39-32-367, 39-30-338
Telex: 22984 SAMKANG

THAILAND
UNISMA Co. Ltd.
20/200 Research Building
2538 Sathorn Ave.
Bangkok, Bangkok
Tel: 39-32-367, 39-30-338
Telex: 22984 SAMKANG

THAILAND
UNISMA Co. Ltd.
20/200 Research Building
2538 Sathorn Ave.
Bangkok, Bangkok
Tel: 39-32-367, 39-30-338
Telex: 22984 SAMKANG

THAILAND
UNISMA Co. Ltd.
20/200 Research Building
2538 Sathorn Ave.
Bangkok, Bangkok
Tel: 39-32-367, 39-30-338
Telex: 22984 SAMKANG

THAILAND
UNISMA Co. Ltd.
20/200 Research Building
2538 Sathorn Ave.
Bangkok, Bangkok
Tel: 39-32-367, 39-30-338
Telex: 22984 SAMKANG

THAILAND
UNISMA Co. Ltd.
20/200 Research Building
2538 Sathorn Ave.
Bangkok, Bangkok
Tel: 39-32-367, 39-30-338
Telex: 22984 SAMKANG

THAILAND
UNISMA Co. Ltd.
20/200 Research Building
2538 Sathorn Ave.
Bangkok, Bangkok
Tel: 39-32-367, 39-30-338
Telex: 22984 SAMKANG

THAILAND
UNISMA Co. Ltd.
20/200 Research Building
2538 Sathorn Ave.
Bangkok, Bangkok
Tel: 39-32-367, 39-30-338
Telex: 22984 SAMKANG

THAILAND
UNISMA Co. Ltd.
20/200 Research Building
2538 Sathorn Ave.
Bangkok, Bangkok
Tel: 39-32-367, 39-30-338
Telex: 22984 SAMKANG

THAILAND
UNISMA Co. Ltd.
20/200 Research Building
2538 Sathorn Ave.
Bangkok, Bangkok
Tel: 39-32-367, 39-30-338
Telex: 22984 SAMKANG

THAILAND
UNISMA Co. Ltd.
20/200 Research Building
2538 Sathorn Ave.
Bangkok, Bangkok
Tel: 39-32-367, 39-30-338
Telex: 22984 SAMKANG

THAILAND
UNISMA Co. Ltd.
20/200 Research Building
2538 Sathorn Ave.
Bangkok, Bangkok
Tel: 39-32-367, 39-30-338
Telex: 22984 SAMKANG

THAILAND
UNISMA Co. Ltd.
20/200 Research Building
2538 Sathorn Ave.
Bangkok, Bangkok
Tel: 39-32-367, 39-30-338
Telex: 22984 SAMKANG

THAILAND
UNISMA Co. Ltd.
20/200 Research Building
2538 Sathorn Ave.
Bangkok, Bangkok
Tel: 39-32-367, 39-30-338
Telex: 22984 SAMKANG

THAILAND
UNISMA Co. Ltd.
20/200 Research Building
2538 Sathorn Ave.
Bangkok, Bangkok
Tel: 39-32-367, 39-30-338
Telex: 22984 SAMKANG

THAILAND
UNISMA Co. Ltd.
20/200 Research Building
2538 Sathorn Ave.
Bangkok, Bangkok
Tel: 39-32-367, 39-30-338
Telex: 22984 SAMKANG

THAILAND
UNISMA Co. Ltd.
20/200 Research Building
2538 Sathorn Ave.
Bangkok, Bangkok
Tel: 39-32-367, 39-30-338
Telex: 22984 SAMKANG

THAILAND
UNISMA Co. Ltd.
20/200 Research Building
2538 Sathorn Ave.
Bangkok, Bangkok
Tel: 39-32-367, 39-30-338
Telex: 22984 SAMKANG

THAILAND
UNISMA Co. Ltd.
20/200 Research Building
2538 Sathorn Ave.
Bangkok, Bangkok
Tel: 39-32-367, 39-30-338
Telex: 22984 SAMKANG

THAILAND
UNISMA Co. Ltd.
20/200 Research Building
2538 Sathorn Ave.
Bangkok, Bangkok
Tel: 39-32-367, 39-30-338
Telex: 22984 SAMKANG

THAILAND
UNISMA Co. Ltd.
20/200 Research Building
2538 Sathorn Ave.
Bangkok, Bangkok
Tel: 39-32-367, 39-30-338
Telex: 22984 SAMKANG

THAILAND
UNISMA Co. Ltd.
20/200 Research Building
2538 Sathorn Ave.
Bangkok, Bangkok
Tel: 39-32-367, 39-30-338
Telex: 22984 SAMKANG

THAILAND
UNISMA Co. Ltd.
20/200 Research Building
2538 Sathorn Ave.
Bangkok, Bangkok
Tel: 39-32-367, 39-30-338
Telex: 22984 SAMKANG

THAILAND
UNISMA Co. Ltd.
20/200 Research Building
2538 Sathorn Ave.
Bangkok, Bangkok
Tel: 39-32-367, 39-30-338
Telex: 22984 SAMKANG

THAILAND
UNISMA Co. Ltd.
20/200 Research Building
2538 Sathorn Ave.
Bangkok, Bangkok
Tel: 39-32-367, 39-30-338
Telex: 22984 SAMKANG

THAILAND
UNISMA Co. Ltd.
20/200 Research Building
2538 Sathorn Ave.
Bangkok, Bangkok
Tel: 39-32-367, 39-30-338
Telex: 22984 SAMKANG

THAILAND
UNISMA Co. Ltd.
20/200 Research Building
2538 Sathorn Ave.
Bangkok, Bangkok
Tel: 39-32-367, 39-30-338
Telex: 22984 SAMKANG

THAILAND
UNISMA Co. Ltd.
20/200 Research Building
2538 Sathorn Ave.
Bangkok, Bangkok
Tel: 39-32-367, 39-30-338
Telex: 22984 SAMKANG

THAILAND
UNISMA Co. Ltd.
20/200 Research Building
2538 Sathorn Ave.
Bangkok, Bangkok
Tel: 39-32-367, 39-30-338
Telex: 22984 SAMKANG

THAILAND
UNISMA Co. Ltd.
20/200 Research Building
2538 Sathorn Ave.
Bangkok, Bangkok
Tel: 39-32-367, 39-30-338
Telex: 22984 SAMKANG

THAILAND
UNISMA Co. Ltd.
20/200 Research Building
2538 Sathorn Ave.
Bangkok, Bangkok
Tel: 39-32-367, 39-30-338
Telex: 22984 SAMKANG

THAILAND
UNISMA Co. Ltd.
20/200 Research Building
2538 Sathorn Ave.
Bangkok, Bangkok
Tel: 39-32-367, 39-30-338
Telex: 22984 SAMKANG

THAILAND
UNISMA Co. Ltd.
20/200 Research Building
2538 Sathorn Ave.
Bangkok, Bangkok
Tel: 39-32-367, 39-30-338
Telex: 22984 SAMKANG

THAILAND
UNISMA Co. Ltd.
20/200 Research Building
2538 Sathorn Ave.
Bangkok, Bangkok
Tel: 39-32-367, 39-30-338
Telex: 22984 SAMKANG

THAILAND
UNISMA Co. Ltd.
20/200 Research Building
2538 Sathorn Ave.
Bangkok, Bangkok
Tel: 39-32-367, 39-30-338
Telex: 22984 SAMKANG

THAILAND
UNISMA Co. Ltd.
20/200 Research Building
2538 Sathorn Ave.
Bangkok, Bangkok
Tel: 39-32-367, 39-30-338
Telex: 22984 SAMKANG

THAILAND
UNISMA Co. Ltd.
20/200 Research Building
2538 Sathorn Ave.
Bangkok, Bangkok
Tel: 39-32-367, 39-30-338
Telex: 22984 SAMKANG

THAILAND
UNISMA Co. Ltd.
20/200 Research Building
2538 Sathorn Ave.
Bangkok, Bangkok
Tel: 39-32-367, 39-30-338
Telex: 22984 SAMKANG

THAILAND
UNISMA Co. Ltd.
20/200 Research Building
2538 Sathorn Ave.
Bangkok, Bangkok
Tel: 39-32-367, 39-30-338
Telex: 22984 SAMKANG

THAILAND
UNISMA Co. Ltd.
20/200 Research Building
2538 Sathorn Ave.
Bangkok, Bangkok
Tel: 39-32-367, 39-30-338
Telex: 22984 SAMKANG

THAILAND
UNISMA Co. Ltd.
20/200 Research Building
2538 Sathorn Ave.
Bangkok, Bangkok
Tel: 39-32-367, 39-30-338
Telex: 22984 SAMKANG

THAILAND
UNISMA Co. Ltd.
20/200 Research Building
2538 Sathorn Ave.
Bangkok, Bangkok
Tel: 39-32-367, 39-30-338
Telex: 22984 SAMKANG

THAILAND
UNISMA Co. Ltd.
20/200 Research Building
2538 Sathorn Ave.
Bangkok, Bangkok
Tel: 39-32-367, 39-30-338
Telex: 22984 SAMKANG

THAILAND
UNISMA Co. Ltd.
20/200 Research Building
2538 Sathorn Ave.
Bangkok, Bangkok
Tel: 39-32-367, 39-30-338
Telex: 22984 SAMKANG

THAILAND
UNISMA Co. Ltd.
20/200 Research Building
2538 Sathorn Ave.
Bangkok, Bangkok
Tel: 39-32-367, 39-30-338
Telex: 22984 SAMKANG

THAILAND
UNISMA Co. Ltd.
20/200 Research Building
2538 Sathorn Ave.
Bangkok, Bangkok
Tel: 39-32-367, 39-30-338
Telex: 22984 SAMKANG

THAILAND
UNISMA Co. Ltd.
20/200 Research Building
2538 Sathorn Ave.
Bangkok, Bangkok
Tel: 39-32-367, 39-30-338
Telex: 22984 SAMKANG

THAILAND
UNISMA Co. Ltd.
20/200 Research Building
2538 Sathorn Ave.
Bangkok, Bangkok
Tel: 39-32-367, 39-30-338
Telex: 22984 SAMKANG

THAILAND
UNISMA Co. Ltd.
20/200 Research Building
2538 Sathorn Ave.
Bangkok, Bangkok
Tel: 39-32-367, 39-30-338
Telex: 22984 SAMKANG

THAILAND
UNISMA Co. Ltd.
20/200 Research Building
2538 Sathorn Ave.
Bangkok, Bangkok
Tel: 39-32-367, 39-30-338
Telex: 22984 SAMKANG

THAILAND
UNISMA Co. Ltd.
20/200 Research Building
2538 Sathorn Ave.
Bangkok, Bangkok
Tel: 39-32-367, 39-30-338
Telex: 22984 SAMKANG

THAILAND
UNISMA Co. Ltd.
20/200 Research Building
2538 Sathorn Ave.
Bangkok, Bangkok
Tel: 39-32-367, 39-30-338
Telex: 22984 SAMKANG

THAILAND
UNISMA Co. Ltd.
20/200 Research Building
2538 Sathorn Ave.
Bangkok, Bangkok
Tel: 39-32-367, 39-30-338
Telex: 22984 SAMKANG

THAILAND
UNISMA Co. Ltd.
20/200 Research Building
2538 Sathorn Ave.
Bangkok, Bangkok
Tel: 39-32-367, 39-30-338
Telex: 22984 SAMKANG

THAILAND
UNISMA Co. Ltd.
20/200 Research Building
2538 Sathorn Ave.
Bangkok, Bangkok
Tel: 39-32-367, 39-30-338
Telex: 22984 SAMKANG

THAILAND
UNISMA Co. Ltd.
20/200 Research Building
2538 Sathorn Ave.
Bangkok, Bangkok
Tel: 39-32-367, 39-30-338
Telex: 22984 SAMKANG

THAILAND
UNISMA Co. Ltd.
20/200 Research Building
2538 Sathorn Ave.
Bangkok, Bangkok
Tel: 39-32-367, 39-30-338
Telex: 22984 SAMKANG

THAILAND
UNISMA Co. Ltd.
20/200 Research Building
2538 Sathorn Ave.
Bangkok, Bangkok
Tel: 39-32-367, 39-30-338
Telex: 22984 SAMKANG

THAILAND
UNISMA Co. Ltd.
2

ACCOPRESS®

25970	YELLOW
25971	BLACK
25972	LIGHT BLUE
25973	DARK BLUE
25974	LIGHT GRAY
25975	LIGHT GREEN
25976	DARK GREEN
25977	TANGERINE
25978	RED
25979	EXECUTIVE RED

GENUINE PRESSBOARD



ACCO USA, INC.
770 S. ACCO PLAZA
WHEELING, IL 60090



81469